

CLAIMS

1. A gene detecting chip having a plurality of pin electrodes that are measurement poles, characterized in that voltages are applied between said pin electrodes and a common electrode that is a counter electrode for said pin electrodes for enabling detection of currents.

2. The gene detecting chip according to claim 1, further characterized by having a common electrode that is a counter electrode for said pin electrodes deployed so as not to contact said pin electrodes.

3. The gene detecting chip according to claims 1 or 2, further characterized by having a recess capable of accommodating said pin electrodes and capable of being filled with sample DNA.

4. The gene detecting chip according to any one of claims 1 to 3, characterized in that genes having different nucleotide sequences are immobilized to said pin electrodes, respectively.

5. The gene detecting chip according to any one of claims 1 to 3, characterized by in that a plurality of PCR products, oligonucleotides, mRNA, cDNA, PNA (peptidic nucleic acid), or LNA (locked nucleic acid; Proligo, a trademark of LLC), having different nucleotide sequences is immobilized to said pin electrodes.

6. The gene detecting chip according to any one of claims 1 to 3, characterized in that genes having the same nucleotide sequence are immobilized to said pin electrodes, respectively.

7. The gene detecting chip according to one of claims 1 to 3, characterized in that PCR products, oligonucleotides, mRNA, cDNA, PNA (peptidic nucleic acid), or LNA (locked nucleic acid; Proligo, a trademark of LLC), having the same nucleotide sequence are immobilized to said pin electrodes.

8. The gene detecting chip according to claims 6 or 7, further characterized by having a plurality of recesses capable of accepting said pin electrodes and capable of being filled with sample DNA, so that said plurality of recesses can be filled with different sample DNAs, respectively.

9. The gene detecting chip according to any one of claims 1 to 8, for detecting gene base sequences, one base substituted SNPs, substitution of several bases, point mutations, translocations, losses, amplifications, or triplet repeats.

10. The gene detecting chip according to any one of claims 1 to 9, characterized in that the surfaces of said pin electrodes are plated with gold.

11. The gene detecting chip according to any one of claims 1 to 10 characterized in that the surfaces of said pin electrodes are partially coated with a resin.

12. The gene detecting chip according to claim 11, characterized in that said resin is PEEK or PTFE.

13. The gene detecting chip according to any one of claims 1 to 12, characterized in that a supporting member is further provided for supporting said pin electrodes, and said pin electrodes are erected on said supporting member.

14. The gene detecting chip according to claim 13, characterized in that said pin electrodes are erected on said supporting member with spot electrodes interposed therebetween.

15. The gene detecting chip according to any one of claims 1 to 12, characterized in that a supporting member is further provided for supporting said pin electrodes, and one end [of each] of said pin electrodes is implanted on said supporting member.

16. The gene detecting chip according to any one of claims 13 to 15, wherein said supporting member is a circuit board.

17. The gene detecting chip according to any one of claims 13 to 16, characterized in that the ends of said pin electrodes, that are in contact with or implanted on

said supporting member, are enclosed by an epoxy resin or PTFE and thereby secured on said supporting member.

18. The gene detecting chip according to any one of claims 13 to 17, characterized in that genes are immobilized only to ends of said pin electrodes that are not the ends in contact with or implanted on said supporting member.

19. The gene detecting chip according to any one of claims 1 to 18, characterized in that genes are fixed over the entirety of said pin electrodes.

20. The gene detecting chip according to any one of claims 13 to 19, having a gap inside thereof, characterized in that:

said pin electrodes are deployed on said supporting member so as to protrude into said gap; and

a portion or entirety of said common electrode is exposed into said gap.

21. The gene detecting chip according to any one of claims 1 to 20, having a main body part and a frame part that can be coupled with said main body part, characterized in that:

said main body part has said pin electrodes on the inner surface thereof; and

said frame part has a recess on the inner surface thereof that, when [said frame part] is coupled with said

main body part, is able to accept said pin electrodes and is able to be filled with sample DNA.

22. The gene detecting chip according to claim 21, wherein said main body part and said frame part are freely attachable to and detachable from each other.

23. A detecting chip for detecting one base substituted SNP and spot mutation in genes, having a main body part and a frame part that are freely attachable to and detachable from each other, characterized in that:

said main body part has a multiplicity of pin electrodes that are protruding measurement poles arranged in a matrix on the inner surface thereof;

said frame part has a recess on the inner surface thereof, that is capable of accepting said multiplicity of pin electrodes when said main body part is mounted [thereto] and capable of being filled with sample DNA;

a common electrode, that is a counter electrode deployed so as not to contact said pin electrodes, is provided in said recess;

PCR products or oligonucleotides having different nucleotide sequences are immobilized to said pin electrodes; and

voltages are applied between said common electrode and said pin electrodes so as to enable detection of currents.

24. The gene detecting chip according to claim 23, characterized in that said pin electrodes are arranged in a multiplicity in matrices, and, by inserting the pin electrodes into each of receptacles accommodating PCR products or oligonucleotides having different nucleotide sequences, said PCR products or oligonucleotides having different nucleotide sequences are immobilized [thereto].

25. The gene detecting chip according to any one of claims 1 to 24, which is for gene diagnostic use.

26. A gene detection apparatus comprising the gene detecting chip described in any one of claims 1 to 25, and a measurement apparatus which said detecting chip can be loaded into and removed from.

27. The gene detection apparatus according to claim 26, characterized in that temperature of said gene detecting chip can be controlled using a Peltier element.

28. A detection method using the gene detecting chip described in any one of claims 1 to 25 is used, characterized in that:

said recess is filled with sample DNA or DNA gene-amplified from said sample DNA;

hybridization is performed to form a double-strand nucleic acid;

after said sample DNA or said DNA gene-amplified from said sample DNA is removed from said recess and washed, said recess is filled with an

electrolyte containing electrochemically active molecules and said electrochemically active molecules are bonded to said double-strand; and

voltages are applied between said common electrode and said pin electrodes and values of currents flowing [therebetween] are detected.

29. A detection method using the gene detecting chip described in any one of claims 1 to 25, characterized in that:

said recess is filled with sample DNA or DNA gene-amplified from said sample DNA and electrolyte containing electrochemically active molecules, and hybridization is performed to form double-strand nucleic acid, while said electrochemically active molecules are bonded to said double-strand; and

voltages are applied between said common electrode and said pin electrodes and values of currents flowing [therebetween] are detected.

30. The detection method according to claim 28 or 29, characterized in that said electrochemically active molecules are bonded to said double-strand while controlling temperature.

31. The detection method according to any one of claims 28 to 30, characterized in that said electrolyte containing said electrochemically active molecules has as its effective component, ferrocene, catecholamine, metal

bipyridine complex, metal phenanthrene complex, viologen, or a threading intercalator in which those compounds are incorporated.

32. A gene diagnostic method wherein the gene detecting chip described in any one of claims 1 to 24 is used.

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